

OPTOELECTRONIC DEVICE FOR METER OPTICAL DETECTOR MODULE
BACKGROUND OF THE INVENTION

Field of the invention

5 The present invention relates to an optoelectronic device for an optical detector module of a meter, in particular a fluid meter, for example a water meter, for remotely measuring the consumption of said meter or carrying out equivalent logging or alarm operations.

Description of the prior art

10 A meter may be provided with an optical detector device comprising a visible consumption indicator taking the form of a rotary indicator disk that has an active sector and an optoelectronic device comprising a sender and a receiver facing the disk. The optical signal
15 received by the receiver is processed to deduce movement of the disk according to whether the signal emitted by the sender is reflected by said active sector or not.

20 Figure 1 shows one embodiment of an optoelectronic device 6 of the above kind comprising a sender 1 and a receiver 2.

 The sender 1 comprises:

- a light-emitting diode 3,
- a resistor Re, and
- a pulsed voltage source Px.

25 The resistor Re is connected at one end to the supply Px and at the other end to the anode of the diode 3.

 The cathode of the diode 3 is connected to ground.

 The receiver 2 comprises:

- 30 - a resistor Rr,
 - a photodiode 4,
 - a voltage source Vdd,
 - a resistor Rth1,
 - a resistor Rth2, and
35 - an operational amplifier 5.

The voltage source V_{dd} is a lithium battery producing a voltage of 3 V or 3.6 V, for example.

5 A voltage pulse P_x of value V_{dd} is generated every 50 ms, for example. This generates a current pulse through the light-emitting diode 3 to generate a light pulse. The current pulse is generated by a voltage V_e across the resistor R_e and equal to $V_{dd} - V_{de}$ where V_{de} is the substantially constant bias voltage across the diode 3.

10 In the event of reflection R of the light pulse by the active sector, the photodiode 4 receives said reflected light pulse, which is converted into a current I_r in the resistor R_r and therefore produces a voltage V_r across the resistor R_r .

15 The voltage V_r is compared to a threshold voltage V_{th} set by the divider bridge formed by the resistors R_{th1} and R_{th2} and the operational amplifier 5 supplies at its output a voltage representative of reception of the light by the photodiode 4.

20 The use of a device of the above kind gives rise to certain difficulties, however.

The voltage source V_{dd} may vary significantly because of various parameters such as temperature and aging, and the use of a high current pulse for other applications can significantly reduce the voltage V_{dd} .
25 The variation of the voltage V_{dd} may be as high as 20%.

The substantially constant bias voltage V_{de} across the diode 3 is 1 V or 1.5 V, for example. The energy transferred to the receiver is proportional to $V_{dd} - V_{de}$.
30 Thus if the voltage V_{dd} varies by $x\%$, the light energy emitted varies by more than $x\%$.

Accordingly, if the voltage V_{dd} is 3 V and the voltage V_{de} is 1.5 V, a 20% variation of the voltage V_{dd} leads to a 40% variation of the light energy transmitted.

35 This kind of variation of the light energy

transmitted, which is not directly proportional to but greater than the variation of the voltage Vdd, makes it extremely difficult to set the threshold voltage Vth. The closer the voltage Vde is to the voltage Vdd, the greater this variation.

The present invention aims to provide an optoelectronic device for an optical detector module of a meter including a sender for generating a light pulse whose variation depends directly on the variation of the voltage supply.

SUMMARY OF THE INVENTION

To this end the present invention proposes an optoelectronic device for use in an optical detector module of a meter comprising a rotary member having a reflective sector, said device comprising:

- a voltage edge source,
- a sender comprising a light-emitting diode emitting a light pulse in response to a current pulse,
- a receiver, and
- a voltage source,

in which device said sender comprises a capacitor and a resistor connected on one side to said voltage source and said capacitor is connected on one side to said voltage edge source and on the other side to the other side of said resistor and to the anode of said light-emitting diode.

Thanks to the invention, the resistor serves as the bias resistor of the light-emitting diode. Accordingly, in the absence of a voltage edge, the light-emitting diode is biased to its bias voltage via the resistor connected to the voltage source. The resistance of this resistor is made sufficiently high to bias the diode with a low forward current so that it substantially does not emit. When a voltage edge is generated in the voltage Vdd, energy equal to the product of the voltage Vdd by

the value of the capacitor is then supplied to the light-emitting diode, which generates a light pulse having a luminous energy equal to the product of the voltage Vdd by the value of the capacitor. This light energy is
5 therefore proportional to the voltage Vdd and a variation of the voltage Vdd will lead to an identical variation of the light energy transmitted.

Moreover, the light pulse is generated entirely by a voltage edge, and not by a pulse, as in the figure 1
10 device. There is therefore no utility in generating a voltage pulse having a particular duration.

Also, the energy transmitted is independent of the bias voltage of the light-emitting diode; as this may also vary, it is beneficial to obtain a transmitted
15 energy independent of such variation.

The resistance of the resistor is advantageously selected to bias the diode whilst maintaining a low forward current in the diode.

In one particularly advantageous embodiment the
20 receiver comprises:

- a comparator for comparing the input voltage of the receiver and a threshold voltage, and
- an adjustment capacitor the charge in which sets the value of the threshold voltage.

25 It is therefore easy to set the threshold voltage, which may depend to a very great extent on the spread of the optoelectronic components used, such as the sender light-emitting diode. The adjustment facility enables adjustment of the threshold voltage if the ratio between
30 the high level and the low level of the comparator is not sufficiently large. The threshold voltage is obtained by precharging the adjustment capacitor for a predetermined time. In the prior art device shown in figure 1, the threshold voltage is set by a resistor bridge and
35 modification of the threshold voltage entails a high

overcost through the need to add new resistors.

The latter embodiment of the optoelectronic device advantageously comprises means for generating a current through the adjustment capacitor for a particular time.

5 The means for generating a current advantageously comprise a microcontroller.

10 The receiver advantageously comprises a charging resistor, the comparator advantageously has an inverting input and a non-inverting input, and the adjustment capacitor is advantageously connected on one side to the inverting input and the charging resistor is advantageously connected on one side to the inverting input.

15 The receiver advantageously comprises auto-adaptation means for adjusting the value of the threshold voltage to the value of the input voltage in the presence of the light pulse.

20 It is particularly advantageous if the receiver comprises a photodiode and a capacitor for storing the energy transferred by the photodiode.

25 Accordingly, the light pulse emitted by the sender may be relatively short, of the order of a few microseconds; this limits power consumption. It suffices to choose a pulse duration sufficient to charge the storage capacitor. In the prior art device shown in figure 1, the voltage across the resistor R_r is accessible only during the light pulse, which must therefore be of sufficient duration to allow adequate processing of the signal.

30 In this latter embodiment, the receiver advantageously comprises a comparator having an inverting input and a non-inverting input and the non-inverting input is connected to the anode of the photodiode and to one side of the storage capacitor.

35 The comparator is an operational amplifier, for

example.

Other features and advantages of the present invention will become apparent in the course of the following description of one embodiment of the invention, which is provided by way of illustrative and non-limiting example.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a prior art optoelectronic device.

Figure 2 shows an optoelectronic device of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 has already been described in relation to the prior art.

Figure 2 shows an optoelectronic device 10 of the invention comprising a sender 20 and a receiver 30.

The sender 20 comprises:

- a light-emitting diode 40,
- a resistor Rpol,
- a voltage edge source Px,
- a capacitor Ce, and
- a voltage source Vdd such as a lithium battery (3 V or 3.6 V).

The capacitor Ce is connected on one side to the voltage edge source Px and on the other side to the anode of the diode 40.

The cathode of the diode 40 is connected to ground.

The resistor Rpol is connected on one side to the voltage source Vdd and on the other side to the anode of the diode 40.

The receiver 30 comprises:

- an operational amplifier 60 having an inverting input and a non-inverting input,
- a microcontroller Py,
- an adjustment capacitor Ct,
- a resistor Rt,

- a storage capacitor C_r ,
- a photodiode 50,
- a switch P_{sw} , and
- the voltage source V_{dd} .

5 The resistor R_t is connected on one side to the microcontroller P_y and on the other side to the inverting input of the operational amplifier 60.

 The adjustment capacitor C_t is connected on one side to ground and on the other side to the inverting
10 input of the operational amplifier 60.

 The switch P_{sw} is connected on one side to the voltage source V_{dd} and on the other side to the cathode of the photodiode 50. The switch P_{sw} is optional and may be replaced by a short circuit. The function of the
15 switch P_{sw} is to disconnect the receiver 30 from the voltage source V_{dd} if the sender 20 is not operating.

 The anode of the photodiode 50 is connected to the non-inverting input of the operational amplifier 60 and to one side of the storage capacitor C_r , the other side
20 of which is connected to ground.

 In the absence of a voltage edge at P_x , the resistor R_{pol} biases the diode 40 to its forward voltage V_{de} . The resistance of the resistor R_{pol} is made sufficiently high to bias the diode to the voltage V_{de}
25 without it emitting light.

 Because there is no voltage edge at P_x , the capacitor C_e is biased between 0 V and V_{de} .

 If a voltage edge of value V_{dd} is emitted at P_x , energy corresponding to the product $V_{dd} \times C_e$ is
30 transferred to the light-emitting diode 40, which generates a light pulse.

 Consequently, the light energy emitted is directly proportional to the supply voltage V_{dd} . Accordingly, if V_{dd} varies by $x\%$, the light energy also varies by $x\%$.

35 In the event of reflection R of the light pulse by

the active sector, the photodiode 50 receives the reflected light pulse, which is converted into a current I_r . The duration of said light pulse may be very short, of the order of a few microseconds. It is sufficient for
5 the current I_r to charge the capacitor C_r . Thus the input voltage V_r of the receiver 30 is stored across the capacitor C_r . The voltage V_r can be processed when the light pulse is no longer present.

The operational amplifier then compares the voltage
10 V_r to a threshold voltage V_t .

The threshold voltage V_t is obtained by precharging the capacitor C_t for a predefined time T_t . Precharging may be carried out using the microcontroller P_y feeding the resistor R_t in series with the capacitor C_t for the
15 time T_t .

The advantage of the above kind of circuit for charging the capacitor C_t lies in programmable, effective and economic adjustment of the threshold voltage with a high resolution, generally provided by the clock of the
20 microcontroller P_y .

Another advantage of this charging circuit is its analog to digital conversion of the received light. The time necessary to charge the capacitor C_t , which is initially discharged, before V_t reaches V_r may also be
25 measured. The microcontroller can then determine the precise value of V_r and then execute auto-adaptation of the value of V_t to that of V_r .

Of course, the invention is not limited to the embodiment that has just been described.

30 Thus the comparator described is an operational amplifier, but may be replaced with any type of comparator.